Limited Circulation

This paper is **not** an official document; it is for information only and must not be quoted in any printed publication without prior permission of the author.

# A short study of the influence of a clear, perforated,plastic film mulch on grass germination.

by J Tamlyn and J R Starr

Agricultural Memorandum No. 1078

## Summary

The covering of two re-seeded areas, in a valley and on a hill top, by clear, perforated plastic film gave rise to accelerated grass germination compared with adjacent unmulched bare soil.

Average temperatures under the mulches were 2.5 C higher on the valley site and 1.6 C higher on the hill than on the respective control bare earth plots.

Mulched soil maximum temperatures were not greatly different from unmulched but minima were noticably higher, such that no ground frosts occurred under the mulch at the valley site although the bare soil registered three such frosts.

## Introduction

Mulching a soil surface has a marked effect on the climate of the soil. In general terms it protects the soil from rainfall impact, decreases evaporation and reduces soil temperature fluctuations. Indirectly it increases the moisture content of the soil, raises the heat capacity (and can result in a slower warming of the soil in Spring). The effects will also depend on mulch colour and whether or not it is impervious to water (WMO 1975, Cook 1981).

Waggoner (1960) for example found that while a transparent film transmitted insolation to the soil the air film beneath the mulch retarded energy loss and the amplitude and mean value of soil temperatures were increased.

Studies by Mahrer et al (1981) indicated that soil heating at the edges of a mulch was lower than at the centre.

Miller and Bunger (1963) in studies on grasses noted soil temperatures were higher under perforated (and unperforated) polythene than for uncovered soils. Indeed Harris (1965) reported clear mulches to increase soil temperatures by up to 8 C over a control soil.

Pusztau (1963) noted a reduction in evaporation losses under plastic mulch and corresponding increases of up to 3 to 4% in moisture content in the surface to 30cm layer. Pest and weed control and control of soil erosion also figure in the advantages of mulches.

The mulching of grasses has application in reseed areas such as golf-greens as reported by Brock (1965); greens were reseeded successfully during winter and early spring using clear polythene mulch and soil temperatures were higher and fluctuated less than those in unprotected soil.

**Types of Mulch**

There are two types: organic (eg. straw) and non organic. In this study the latter type of mulch was used - a perforated clear, plastic film. The mulch was used as a 'floating cover' for the germination of grass. ie. the grass was not planted through the perforations. (The non perforated film is often used as a surface mulch or to cover loops to make low tunnels) (MAFF 1984)

**The Mulching Study**

The study was carried out at the request of the Agronomy Department, Trawsgoed, as a part of their work on herbage quality. Two convenient sites (on National Institute for Agricultural Botany trial sites at Trawsgoed), one in the valley at 60m above sea level (asl), the other, on an adjacent hill site at 300m asl, were reseeded with 4 varieties of grass seed on the afternoon of 12th September 1986.

The re-seeded plots were about 10m X 10m (valley) and 10m X 20m (hill); an area within each was mulched with a perforated, clear plastic film 'Polycrop'. The film covered half of the four sown grass strips of each variety, the other half being left unmulched (fig 1a).Three widths of mulch were used on the valley site, two on the hill; edges were held down with bags of earth.

Squirrel automatic data loggers with appropriate temperature sensors were installed on 15th September. At each site four temperature sensors were used. Two were placed under the mulch, lightly covered by soil, one in the unmulched bare soil and one in a nearby grass plot; the layouts are illustrated in figs 1 b&c. (Note: in the valley one sensor was in the centre of the mulched plot the other nearer the edge; on the hill, with only two mulch strips both were near edges.)

Plots were adjacent to Met. sites, at which 30cm soil and screen temperatures and rainfall were monitored; the daily observations are tabulated in tables 1 a&b (at the hill site data are collected weekly).

The mulch was removed in the afternoon of 24 September when the Agronomy field team observed that the grass under the mulches had achieved the 1 to 1½ leaf stage. At this time grass was only just visible in the unmulched areas

Recording continued until the afternoon of the 26th. Only 1.2mm of rainfall fell on the valley site and 6.6mm on the hill site (both amounts on the 17th).

**Discussion of results**

Epson plotted graphs of temperature recorded at both sites are displayed in figs 2 a, b for the period 15 to 26 September 1986.

The average temperature 'lift' afforded by the mulch was apparently 2.5 C at the valley site, and 1.6 C on the hill. Data are plotted schematically in figs 3 a, b together with screen and 30cm soil temperature. These data show that, on average, the bare soil maximum was close to the mulch maximum at both sites, but that the bare soil minimum was consistently lower than the mulch soil minimum; this was particularly noticable in the valley site where three nights of ground frost were measured on the unmulched soil and none on the mulched soil.

Degree-days above base 6 C were calculated from the daily maxima and minima for 15-24 September and estimated for the 12th - 15th September. They are tabulated in tables 2a, b. According to the field team, on both plots, valley and hill, the reseed areas under mulch were at a similar development stage. The tables indicate that the **unmulched** plot in the valley had achieved a similar number of degree days above 6 C as had the **mulched** hill site. One might have thought that, on accumulated temperature consideration alone, similar grass development should be apparent on both these plots. However, the valley bare soil plot was subject to three nights of ground frost, which would set back grass development.

Lapse rates were calculated for maximum and minimum temperatures, under mulch and on bare soil (the mulch figures were taken as the average of both sets of sensors) Results (table 3) show that the minimum temperature under mulch was increased to such an extent that the average minimum under mulch on valley and hill sites were virtually the same, (ie. lapse rate about zero) whereas the average bare soil minimum temperature lapse rate was (-) 1.2 C / 100m.

**Table 3 : Lapse rates (-) C per 100m**

| plot | max temp | min temp | average |
|---|---|---|---|
| bare soil | 2.0 | 1.2 | 1.6 |
| mulched area | 2.2 | 0.0 | 1.1 |
| grass | 3.2 | 2.4 | 2.8 |

Very little rain fell over the period and none during the preceeding week. Accordingly the bare soil had developed a 'friable' surface layer which, in reducing heat conduction from below on radiation nights, would have increased the frost risk compared with a more moist soil. Moisture in the top soil was conserved by mulching as revealed by scraping the soil at the end of the study when the mulched soil showed a darker, (moister) appearance compared with the adjacent unmulched plot)

After removal of the mulch on the 24th monitoring continued. The data are summarised below.

**Table 4:**

**Without Mulch**

| site | max temp C | min temp C |
|---|---|---|
| valley 'mulched area' | 32.5 | 2.1 |
| bare soil | 35.2 | 3.2 |
| hill 'mulched area' | 24.8 | 3.8 |
| bare soil | 28.2 | 4.8 |

The influence of katabatic flow on the valley site minimum temperatures shows clearly; while the 'bare soil' maxima are higher compared with the formally mulched area. This suggests the extra retained moisture in the surface layers of the latter gives the soil an added thermal capacity, depressing maxima compared with 'bare soil.On radiation nights the moisture aids thermal conduction from below resulting in minima being higher on the formally mulched area.

**Acknowledgements:**

The study was carried out in cooperation with the Agronomy Field Team at Trawsgoed.

**References:**

Brock J R. (1965) Grass under plastic. Golf Course Reptr., Reprinted in "Parks", pp 512, 514. (In WMO 1975)

Cook S D. (1981) The effect of polythene mulches on soil temperatures in an over wintered carrot crop. Agricultural Memorandum 930 (Meteorological Office)

Harris R E. (1965) Polythene covers and mulches for corn and bean production in northern regions. Proc. Amer. Soc. hort. Sci., 87, pp. 288-294. (in WMO 1975).

MAFF (1984) Plastic film covers for vegetable production. Booklet 2434

Mahrer Y Q; Katan J (1981) Spatial soil temperature régime under transparent polythene mulch - numerical and experimental studies. Soil Science Vol 131 No.2 82 - 87

Miller D E, Bunger W C. (1963) Use of plastic soil covers in sweet corn production. Agron. J., 55 (5), pp 417-419 (in WMO 1975)

Waggoner P E (1960) Mulches and energy balance at the soil surface. Trans. 7th Int Congr. Soil Sci. 1 pp 164-168

WMO (1975) Mulching effects on plant climate and yield. Editor J W Davies. World Meteorological Organisation, Technical Note 136

Any comments or suggestions on this paper should be sent to the authors.

Agro-meteorological Dept. for Wales,
ADAS/WOAD Trawsgoed,
Aberystwyth, Dyfed.

October 1986

**Table 1a**

| Trawsgoed Valley (60m) | | | | |
|---|---|---|---|---|
| date Sept 1986 | 30cm soil | Av bare soil | screen max | screen min |
| 8 | 14.8 | | | |
| 9 | 14.7 | | | |
| 10 | 14.3 | | | |
| 11 | 14.0 | | | |
| 12 | 14.0 | | 15.3 | 7.6 |
| 13 | 13.8 | | 14.4 | 4.4 |
| 14 | 13.5 | | 14.5 | 2.0 |
| 15 | 13.0 | | 13.4 | 2.4 |
| 16 | 12.7 | 17.6 | 15.6 | 0.2 |
| 17 | 12.6 | 15.2 | 14.3 | -0.8 |
| 18 | 12.2 | 15.4 | 15.8 | 3.6 |
| 19 | 12.0 | 14.4 | 15.5 | 1.1 |
| 20 | 11.7 | 15.6 | 17.2 | 0.1 |
| 21 | 12.0 | 17.9 | 15.3 | 4.5 |
| 22 | 12.4 | 22.2 | 16.5 | 9.1 |
| 23 | 12.7 | 17.3 | 15.5 | 7.0 |
| 24 | 12.8 | 16.4 | 16.0 | 7.5 |
| 25 | 12.6 | | 16.2 | 3.9 |
| 26 | 12.4 | | 14.5 | 4.1 |
| 27 | 12.7 | | | |
| 28 | 13.0 | | | |
| 29 | 13.5 | | | |

Rainfall: 1.3mm on 17th

**table 1b**

| Talgarth Hill (300m) | | | |
|---|---|---|---|
| 30cm soil | Av bare soil | screen max | screen min |
| 13.9 | | 13.0 | 9.8 |
| | | 14.8 | 7.6 |
| | | 13.8 | 8.0 |
| | | 13.8 | 5.8 |
| | | 12.6 | 7.2 |
| | | 12.4 | 5.8 |
| | | 12.6 | 5.8 |
| 10.1 | | 11.2 | 5.2 |
| | 9.8 | 12.0 | 4.2 |
| | 9.3 | 11.8 | 3.6 |
| | 10.9 | 12.6 | 5.6 |
| | 10.3 | 12.6 | 5.8 |
| | 11.7 | 15.0 | 6.0 |
| | 12.5 | 13.2 | 7.0 |
| 11.3 | 15.1 | 14.6 | 9.2 |
| | 13.1 | 13.4 | 9.2 |
| | 12.4 | 13.2 | 10.0 |
| | 11.9 | 14.2 | 6.2 |
| | | 13.0 | 8.2 |
| | | 14.4 | 10.0 |
| | | 14.4 | 11.8 |
| 11.9 | | 15.8 | 10.2 |

Rainfall 6.6mm on 17th

all temperatures in degrees Centigrade.

**Table 2a**

Talgarth hill (300m)

| | <------- 15-24 September -------> | | | 12-15 Sept | |
|---|---|---|---|---|---|
| sensor | Av Temp | difference | Day deg > 6 C | Estimated Day-deg > 6 C | Total Day-deg during germination |
| mulch 1 | 13.0 | 1.6 | 86 | 22 | 120 |
| mulch 2 | 13.4 | | 101 | 29 | |
| bare soil | 11.6 | | 71 | 10 | 81 |
| grass | 9.6 | | 55 | 13 | 68 |

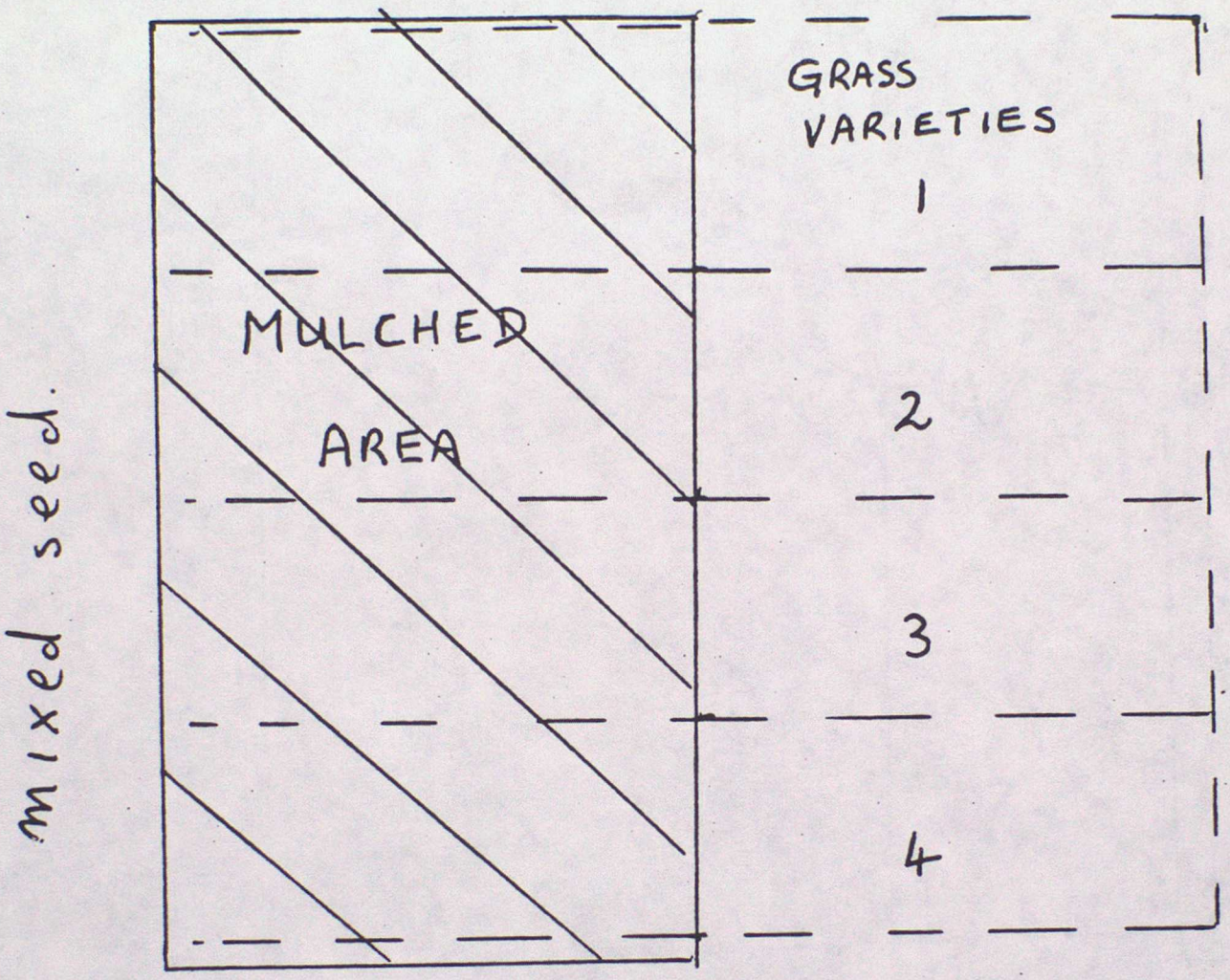
**Table 2b**

Trawsgoed valley (60m)

| | | | | | |
|---|---|---|---|---|---|
| mulch 1 | 14.8 | 2.5 | 122 | 30 | 147 |
| mulch 2 | 14.6 | | 112 | | |
| bare soil | 12.2 | | 103 | 20 | 123 |
| grass | 9.4 | | 61 | 4 | 65 |

# Sketch of Layout of Variety Trial Sites

Fig. 1a




(Figs 1 a, b & c - not to Scale)

Varieties : Melle - P
R.V.P - I
Frances - P
Talbot - P

P : Perennial Rye Grass
I : Italian " "

Fig. 1b

Valley Site (60 m asl)

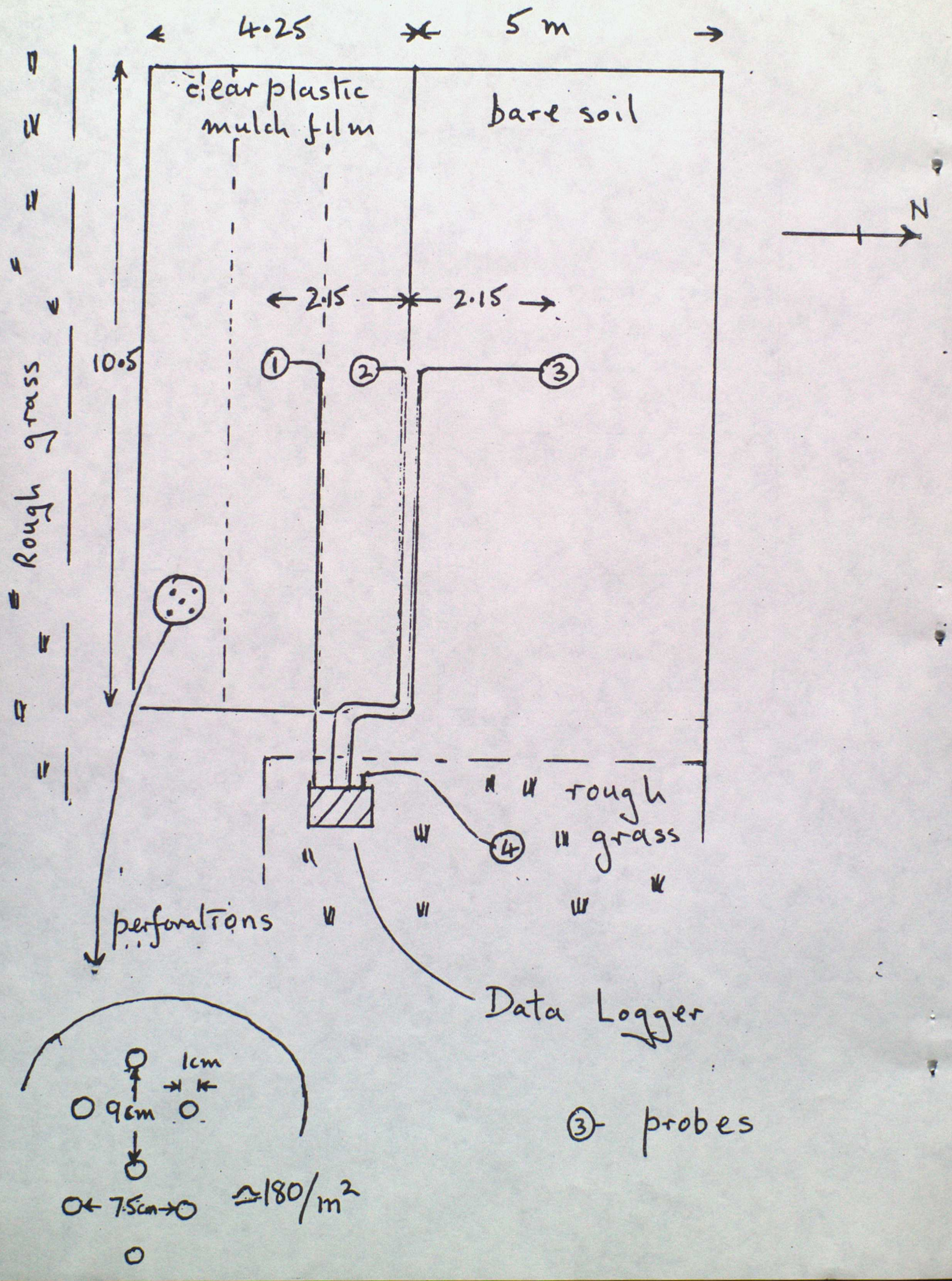
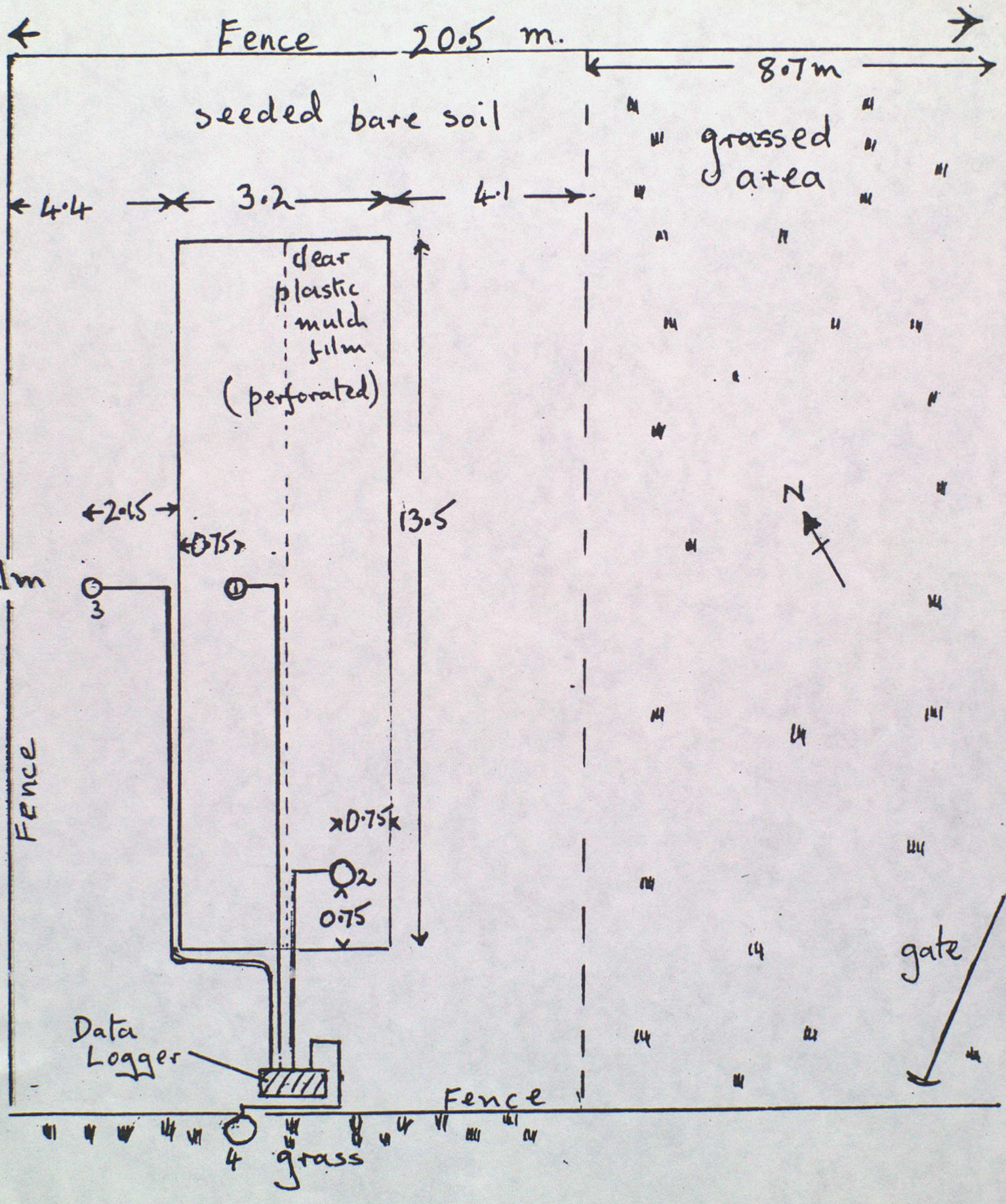


Fig. 1c

# Hill Site (300m asl)

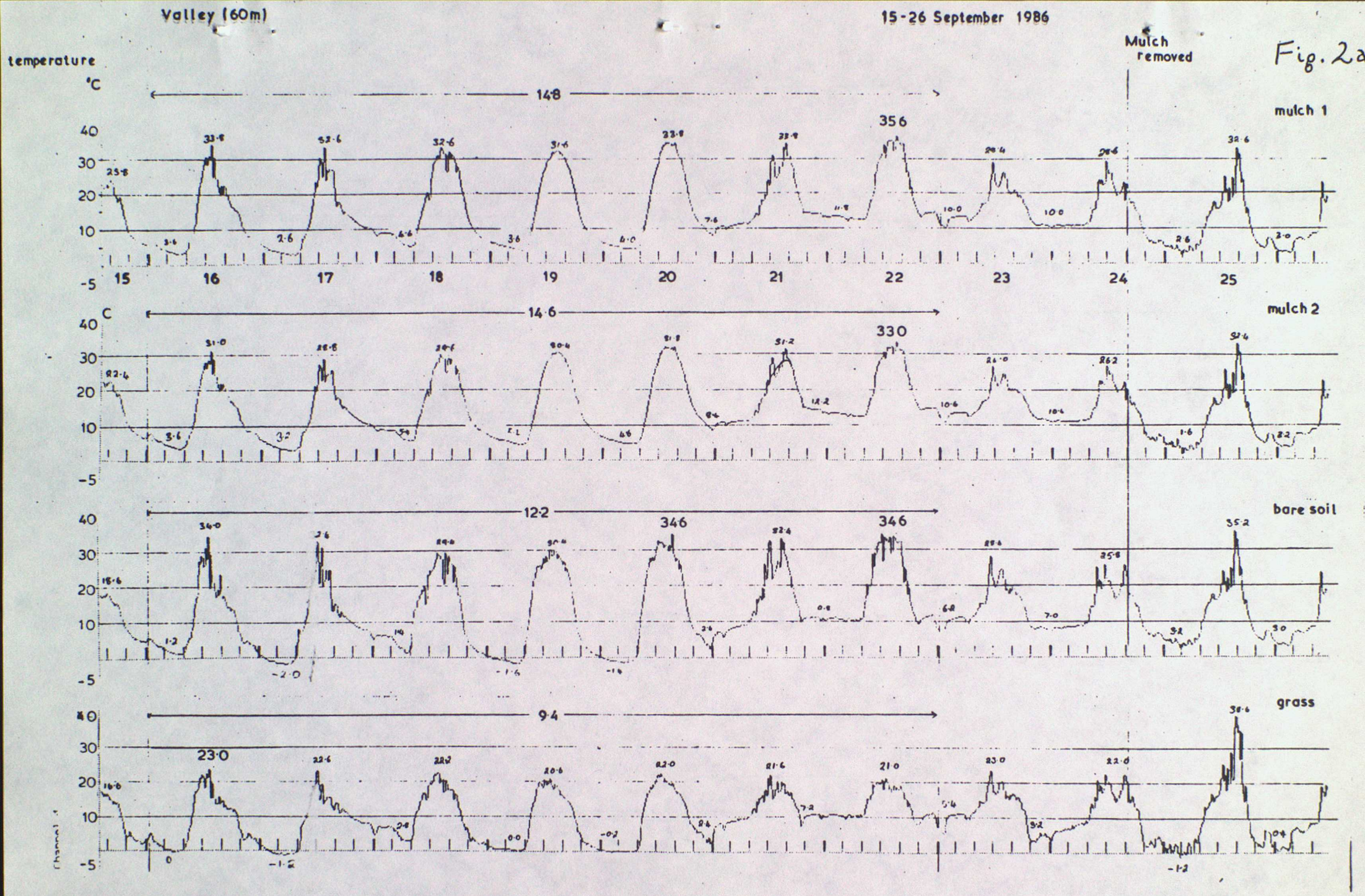



○3 : probes

Valley (60m)

15-26 September 1986

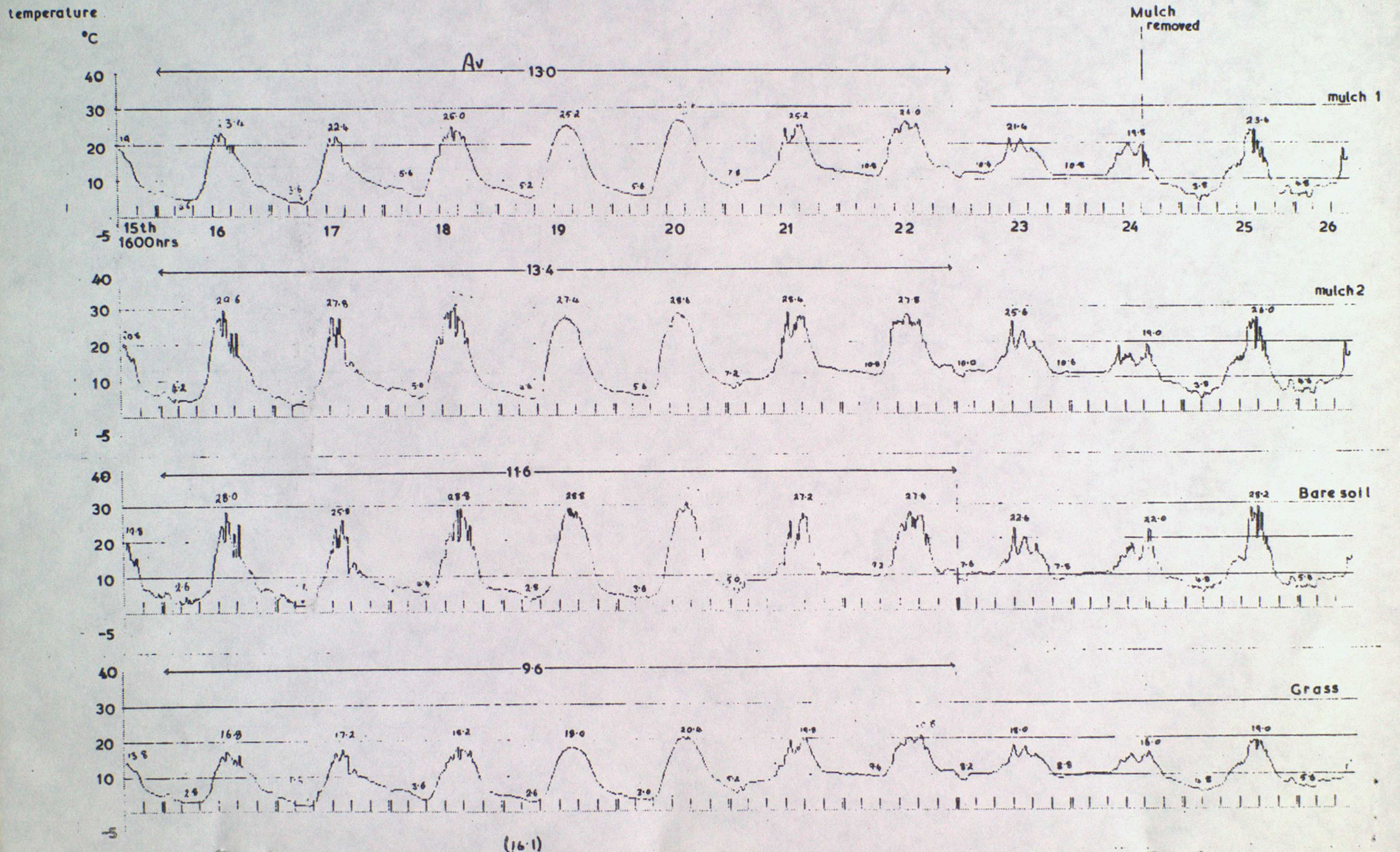
Fig. 2a



Hill (Talgarth 300m)

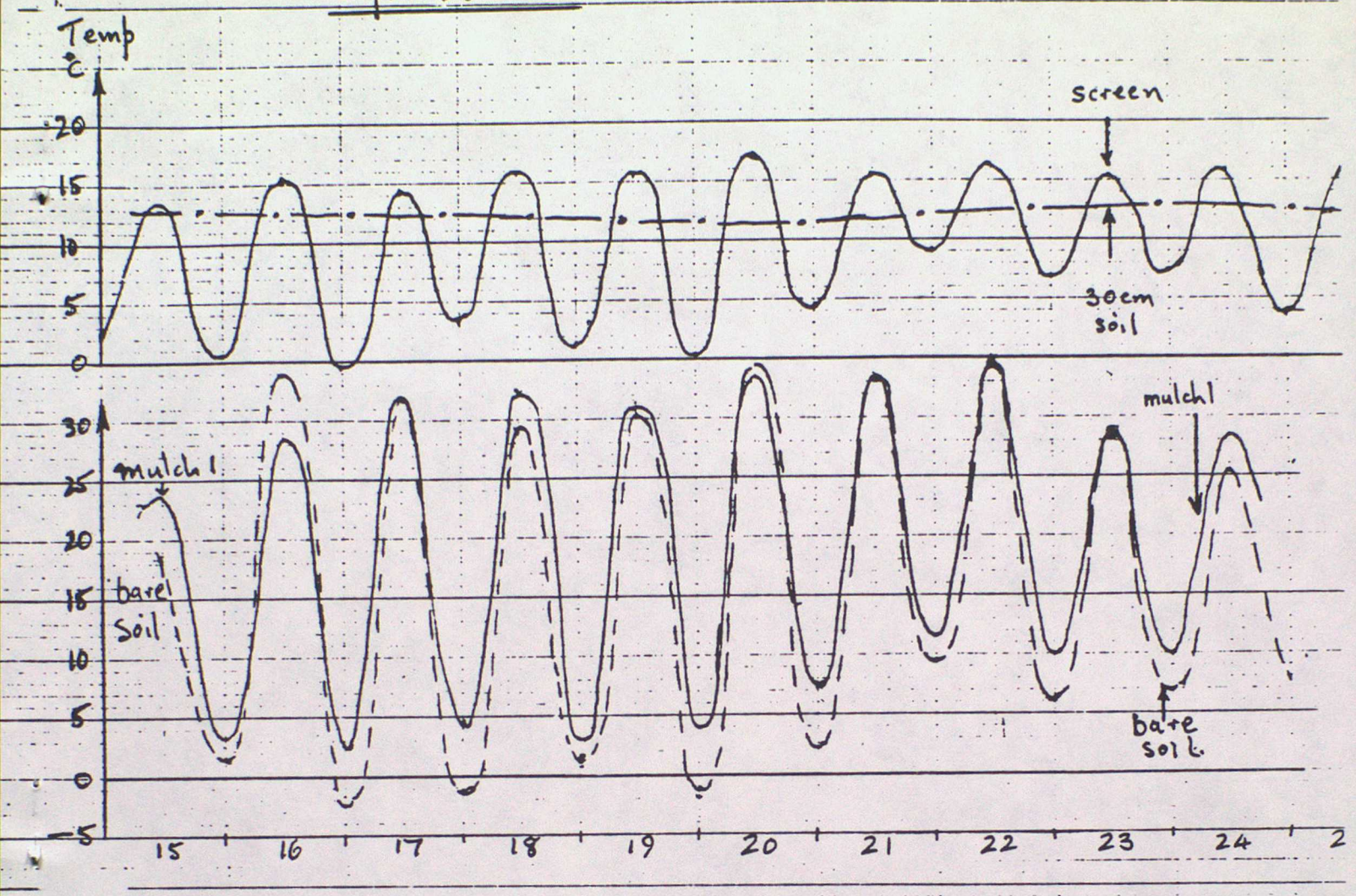
15 - 26 September 1986

Fig. 2b



Trawsgoed valley site (60m) Fig. 3a

September 1986




Talgarth hill site (300m) Fig. 3b